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## ELECTRICAL ADAPTER

### FIELD OF THE INVENTION

5           This invention relates generally to the field of electrical hardware and more specifically to the field of electrical power connectors for use in electrical hardware.

### BACKGROUND OF THE INVENTION

10           Many electrical devices include an internal bulk power supply (BPS) used to convert alternating current (AC) power supply signals to lower voltage direct current (DC) power supply signals. Often a connector is attached to the chassis of the electrical device allowing a separate power cord to plug into the device. The connector is electrically connected to the bulk power supply within the chassis, often with wires from the connector to the BPS.

15           This common configuration creates a number of problems. Many electrical components, such as integrated circuits, may be susceptible to electro-magnetic interference (EMI) inherent in high frequency components of the AC power supply signals. A variety of methods are commonly used to reduce this interference. AC line filters are used to reduce the high frequency components of the AC power supply signals.

20           Shielding is often used around the power supply to contain high frequency emissions from the bulk power supply within the system. However, shielding adds to cost and makes replacement of the power supply more difficult.

### SUMMARY OF THE INVENTION

25           An AC-to-AC adapter is configured to float on a computer chassis, backplane, or wall of a computer case allowing bulk power supplies to be physically located adjacent to

the backplane. This allows use of an EMI gasket between the bulk power supply and the backplane preventing high frequency noise from radiating out of the computer case. Standard electrical plugs may be used on one or both sides of the adapter allowing standard bulk power supplies and line cords to be used on one or both sides of the adapter.

Other aspects and advantages of the present invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a front view of an example embodiment of an AC-to-AC adapter according to the present invention.

Figure 2 is a back view of the example embodiment of an AC-to-AC adapter of Figure 1 according to the present invention.

Figure 3 is a top view of the example embodiment of an AC-to-AC adapter of Figure 1 according to the present invention.

Figure 4 is a side view of the example embodiment of an AC-to-AC adapter of Figure 1 according to the present invention.

Figure 5 is a front view of an example embodiment of an AC-to-AC adapter according to the present invention.

Figure 6 is a side view of the example embodiment of an AC-to-AC adapter of Figure 1 according to the present invention attached to a bulk power supply and a chassis.

Figure 7 is an example embodiment of a computer system including an AC-to-AC adapter according to the present invention.

## DETAILED DESCRIPTION

Figure 1 is a front view of an example embodiment of an AC-to-AC adapter **100** according to the present invention. This example embodiment of the present invention is an AC-to-AC adapter **100** configured to attach to a backplane on an electrical device.

5 The front view of the adapter shows the side of the adapter **100** that resides on the outside of the electrical device. The AC-to-AC adapter **100** shown in figure 1 includes an outside AC connector **102** including a ground pin **104** and hot and neutral pins **106**. The ground pin **104** is electrically connected to a ground wire **108** through the body of the AC-to-AC adapter **100** with a wire **110** or other electrically conductive material. The ground wire **108** is terminated in a ground connector **112** allowing electrical connection between the ground pin **104** and the backplane of an electrical device. In this example embodiment of the present invention the outside AC connector **102** is a standard IEC 320 (as of January 1, 2002) 20 amp receptacle that accepts a standard IEC 320 (as of January 1, 2002) 20 amp plug. Many other configurations of the outside AC connector **102** may be substituted within the scope of the present invention. Since the adapter **100** includes a ground wire **108** that may be electrically connected to a backplane, the adapter **100** does not need to allow for electrical connection to ground through the means for connecting the adapter **100** to a backplane. The adapter may then move up and down, or side to side with respect to the backplane as needed to allow for misalignments in a bulk power supply as it is attached to the adapter **100** within the electrical device that the adapter **100** is attached to.

Many current computer chassis include a power connector externally similar to that of the present invention. However, in many cases power wires are used to bring power from the connector to an internal bulk power supply. Some computer chassis include metal shielding completely surrounding the bulk power supply, wire, and

connector, however, this adds cost to the computer system, and adds to repair time required to change out a failed power supply.

The AC-to-AC adapter **100** of the present invention allows construction of bulk power supplies configured to plug directly into the adapter **100** and to include a built-in AC line filter. The connection between the AC-to-AC adapter **100** and the bulk power supply may then be EMI shielded from the rest of the computer through the use of an EMI gasket between the bulk power supply and the chassis surrounding the connection between the adapter **100** and the bulk power supply. Since the case of the bulk power supply acts as an EMI shield, using an EMI gasket between the bulk power supply and the computer chassis fully encloses all AC power supply lines within an EMI shield.

For safety reasons, the case of the bulk power supply must be electrically connected to the computer chassis and ground. If the case of the power supply is allowed to float while connected to an AC power source, dangerous voltages may develop between the case and ground. Thus, the case of the power supply must be securely electrically connected to ground while power is applied. Many computer systems use a separate wire from the case of the bulk power supply to the computer chassis to ground the power supply case. When replacing bulk power supplies, power to the supply must be shut off before removing this ground wire, thus making hot swapping of the power supply more time consuming and possibly dangerous. The AC-to-AC adapter **100** of the present invention eliminates the necessity of this separate wire since the ground pin/slot is electrically connected to a ground wire **108** that is then electrically connected to the backplane or chassis with a ground connector **112**. When the bulk power supply is plugged in to the adapter **100**, the ground connection to the backplane or chassis is also accomplished. Thus, safe hot swapping of the bulk power supply may now be possible.

Some computer system designers use EMI shielding gaskets between the case of the bulk power supply and the computer backplane or chassis to act also as a ground connection between the power supply and the chassis. However, when removed from the chassis, EMI shielding may be delicate and prone to damage, thus raising the possibility of poor ground integrity throughout the life of the computer system. The AC-to-AC adapter **100** of the present invention reduces that risk since the ground connection **110** is within the adapter itself and is undisturbed during replacement of the bulk power supply.

Figure 2 is a back view of the example embodiment of an AC-to-AC adapter of Figure 1 according to the present invention. This example embodiment of the present invention is an AC-to-AC adapter **100** configured to attach to a backplane on an electrical device. The back view of the adapter shows the side of the adapter **100** that resides on the inside of the electrical device. The AC-to-AC adapter **100** shown in figure 2 includes an inside AC connector **200** including a ground slot **202** and hot and neutral slots **204**. The ground slot **202** is electrically connected to the ground pin **104** shown in Figure 1. The ground slot **202** is also electrically connected to the ground wire **108** through the body of the AC-to-AC adapter **100** with a wire **110** or other electrically conductive material. The ground wire **108** is terminated in a ground connector **112** allowing electrical connection between the ground slot **202**, the ground pin **104** and the backplane of an electrical device. The inside AC connector **200** is configured to connect to a standard bulk power supply. In this example embodiment of the present invention the inside AC connector **200** is a standard IEC 320 (as of January 1, 2002) 20 amp plug that connects with a standard IEC 320 (as of January 1, 2002) 20 amp receptacle. Many other configurations of the inside AC connector **200** may be substituted within the scope of the present invention. This connector **200** may be configured to connect to any desired bulk power supply or any other electrical device within the scope of the present invention. Since the adapter

100 includes a ground wire 108 that may be electrically connected to a backplane or chassis, the adapter 100 does not need to allow for electrical connection to ground through the means for connecting the adapter 100 to a backplane or chassis. The adapter may then move up and down, or side to side with respect to the backplane or chassis as  
5 needed to allow for misalignments in a bulk power supply as it is attached to the adapter 100 within the electrical device that the adapter 100 is attached to.

Figure 3 is a top view of the example embodiment of an AC-to-AC adapter of Figure 1 according to the present invention. This example embodiment of the present invention is an AC-to-AC adapter 100 configured to attach to a backplane on an electrical  
10 device. The top view of the adapter shows the adapter 100 that is configured to connect to a backplane or chassis allowing movement in two axes. The example embodiment of the present invention includes two cutouts 300 configured to allow attachment to a backplane or chassis with some up and down, and side to side movement, but little in and out movement with respect to the backplane or chassis. Many other attachment means  
15 may be used within the scope of the present invention to attach the adapter 100 to a backplane or chassis. This top view shows both the inside AC connector 200 and the outside AC connector 102. The ground wire 108 has been removed for illustration purposes and the wire 110 or other electrical conductor used to connect the ground pin 104 and ground slot 202 is shown on the top of the adapter 100.

Figure 4 is a side view of the example embodiment of an AC-to-AC adapter of Figure 1 according to the present invention. This example embodiment of the present invention is an AC-to-AC adapter 100 configured to attach to a backplane on an electrical  
20 device. The side view of the adapter shows the adapter 100 that is configured to connect to a backplane or chassis allowing movement in two axes. The example embodiment of the present invention includes two cutouts 300 configured to allow attachment to a  
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backplane or chassis with some up and down, and side to side movement, but little in and out movement with respect to the backplane or chassis. Many other attachment means may be used within the scope of the present invention to attach the adapter **100** to a backplane or chassis. This side view shows both the inside AC connector **200** and the outside AC connector **102**.

Figure 5 is a front view of an example embodiment of an AC-to-AC adapter according to the present invention. This example embodiment of the present invention is an AC-to-AC adapter **500** configured to attach to a backplane on an electrical device. The front view of the adapter shows the side of the adapter **500** that resides on the outside of the electrical device. The AC-to-AC adapter **500** shown in figure 5 includes an outside AC connector **502** including a ground pin **504** and hot and neutral pins **506**. This example embodiment of the present invention is similar to the embodiment shown in Figures 1 through 4 with the exception of the outside AC connector **502**. In this example embodiment a different outside AC connector **502** is used with a different configuration of ground **504** and hot and neutral pins **506**. The ground pin **504** is electrically connected to a ground wire **508** through the body of the AC-to-AC adapter **500** with a wire **510** or other electrically conductive material. The ground wire **508** is terminated in a ground connector **512** allowing electrical connection between the ground pin **504** and the backplane of an electrical device. The outside AC connector **502** is configured to connect to a standard electrical power cord. This connector **502** may be configured to connect to any desired electrical power cord within the scope of the present invention. Since the adapter **500** includes a ground wire **508** that may be electrically connected to a backplane, the adapter **500** does not need to allow for electrical connection to ground through the means for connecting the adapter **500** to a backplane. The adapter may then move up and down, or side to side with respect to the backplane as needed to allow for misalignments



in a bulk power supply as it is attached to the adapter **500** within the electrical device that the adapter **500** is attached to.

Figure 6 is a side view of the example embodiment of an AC-to-AC adapter of Figure 1 according to the present invention attached to a bulk power supply and a chassis.

5 This view of the AC-to-AC adapter includes the bulk power supply **602** that connects to the adapter **100** along with the chassis **600** that the adapter **100** is attached to in a method allowing movement in two axes. EMI shielding **604** material is shown between the chassis **600** and the power supply **602**. This EMI shielding **604** contains the high frequency noise from escaping through the connector system chassis openings, and may  
10 be an EMI gasket.

Figure 7 is an example embodiment of a computer system including an AC-to-AC adapter according to the present invention. The computer system shown in Figure 7 includes an enclosure **700** surrounding at least part of a chassis **600** including a power supply **708** that is connected to an AC-to-AC adapter **100** that, in turn, is mechanically  
15 connected to the chassis **600** in a method allowing movement in two axes, and is electrically connected to the chassis **600** through a ground wire **108** and ground connector **112**. The computer system includes a display **702**, a keyboard **704**, and a mouse **710**.

The foregoing description of the present invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the  
20 invention to the precise form disclosed, and other modifications and variations may be possible in light of the above teachings. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application to thereby enable others skilled in the art to best utilize the invention in various embodiments and various modifications as are suited to the particular use contemplated. It is intended that

the appended claims be construed to include other alternative embodiments of the invention except insofar as limited by the prior art.

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